CLAIMS

We claim:

1. A waveguide comprising:

at least one outer surface defining a waveguide cavity; and

at least one inner surface positioned within said waveguide cavity, wherein said inner surface comprises a frequency selective surface (FSS) having a plurality of frequency selective surface elements coupled to at least one substrate, said substrate defining a first propagation medium such that an RF signal having a first wavelength in said first propagation medium can pass through said frequency selective surface;

wherein said frequency selective surface is coupled to a second propagation medium such that in said second propagation medium said RF signal has a second wavelength which is at least twice as long as a physical distance between centers of adjacent ones of said frequency selective surface elements.

2. The waveguide of claim 1, wherein said second wavelength is different than said first wavelength.

3. The waveguide of claim 1, wherein said substrate comprises a dielectric having at least one of a relative permittivity and a relative permeability which is greater than 3.

4. The waveguide of claim 1, wherein said frequency selective surface comprises a plurality of dielectric layers.

5. The waveguide of claim 1, wherein said frequency selective surface comprises at least one dielectric layer for matching an impedance of said first propagation medium to an impedance of said second propagation medium.

6. The waveguide of claim 1, wherein said frequency selective surface elements comprise apertures in a conductive surface.

7. The waveguide of claim 1, wherein said frequency selective surface elements comprise conductive elements.

8. An antenna for microwave radiation comprising:

a first horn; and

at least a second horn positioned within said first horn, said second horn comprising at least one frequency selective surface having a plurality of frequency selective surface elements coupled to at least one substrate, said substrate defining a first propagation medium such that an RF signal having a first wavelength in said first propagation medium can pass through said frequency selective surface;

wherein said frequency selective surface is coupled to a second propagation medium such that in said second propagation medium said RF signal has a second wavelength which is at least twice as long as a physical distance between centers of adjacent ones of said frequency selective surface elements.

9. The antenna of claim 8, wherein said second wavelength is different than said first wavelength.

10. The antenna of claim 8, further comprising at least a third horn positioned within said second horn, said third horn comprising at least one frequency selective surface.

11. The antenna of claim 8, wherein said substrate comprises a dielectric having at least one of a permittivity and a permeability which is greater than 3.

12. The antenna of claim 8, wherein said frequency selective surface elements comprise apertures in a conductive surface.

13. The antenna of claim 8, wherein said frequency selective surface elements comprise conductive elements.

14. The antenna of claim 8, wherein said frequency selective surface comprises a plurality of dielectric layers.

15. The antenna of claim 8, wherein said frequency selective surface comprises at least one dielectric layer matching an impedance of said first propagation medium to an impedance of said second propagation medium.

16. A waveguide horn antenna comprising,

a tapered hollow metallic conductor; and

a frequency selective surface comprising a substrate and an array of elements defining at least one wall of said horn, said frequency selective surface positioned for confining and guiding a propagating electromagnetic wave;

said substrate having at least one of a permeability and a permittivity greater than about three.

17. The waveguide horn antenna according to claim 16 wherein said frequency selective surface is comprised of concentric ring slots.

18. A method for improving performance in a horn antenna comprising the steps of:

forming at least one wall of said horn antenna of a frequency selective surface; and

selectively reducing at least one grating lobe of said antenna by increasing at least one of a permittivity and a permeability of a substrate comprising said frequency selective surface to a value greater than three.

19. The method according to claim 18 further comprising the step of increasing said value of at least one of said permeability and said permittivity to between about 10 and 100.

20. The method according to claim 18 further comprising the step of reducing at least one grating lobe of said antenna by decreasing a spacing between adjacent elements of said frequency selective surface.